U.S. DEPARTMENT OF ENERGY | Nuclear Energy

Nuclear Energy University Programs (NEUP)
Fiscal Year (FY) 2015 Annual Planning Webinar

Mission Supporting: Fuel Cycle Technologies (MS-FC-1)

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Fuel Cycle Research and Development Mission

DOE Mission: Enhance U.S. security and economic growth through transformative science, technology innovation, and market solutions to meet our energy, nuclear security, and environmental challenges
Goal 1: Energy and Science
Goal 2: Nuclear Security
Goal 3: Management and Performance

DOE

Advance nuclear power as a resource capable of making major contributions in meeting the Nation's energy supply, environmental, and energy security needs by resolving technical, cost, safety, security and regulatory issues through research, development, and demonstration.

NE

Develop used fuel waste management strategies and sustainable fuel cycles that improve resource utilization, minimize waste generation, improve safety and limit proliferation risk.

FCR&D

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Fuel Cycle Research and Development Objectives

Near Term

- Address BRC recommendations for Used Fuel Disposition.
- Increase focus on accident tolerant fuels.
- Down select fuel cycle options for further development.

Medium Term

- Conduct science based, engineering driven R&D for selected fuel cycle options.
- Complete plans for developing a dry storage demonstration project for extended storage of used nuclear fuel.
- Evaluate benefits of various geologic media for disposal.

Long Term

- Demonstrate the selected fuel cycle options at engineering scale.
- Operate a dry storage demonstration project for extended storage of used fuel.
- Conduct engineering analysis of disposal site(s) for selected geologic media.

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Fuel Cycle Research and Development: an Integrated Approach

Front End

Uranium Resources

- Conventional production
- Innovative approaches
  - U Seawater

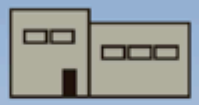
Fuel Fabrication

- Safety enhanced LWR fuel
  - Accident tolerance
- Higher performance
  - Improved burnup

Reactors

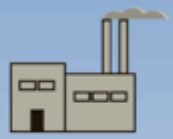
- Light Water Reactors
- Advanced Fast Reactors

Back End



Interim Storage

- Evaluating extended time frames
- Transport after storage



Recycle

- Separations
- Recycled fuel
- Secondary waste treatment

Disposal

- Alternative geologies
- Alternative waste forms

←----------Safeguards and Security By Design----------→

Optimize through Systems Analysis, Engineering, and Integration

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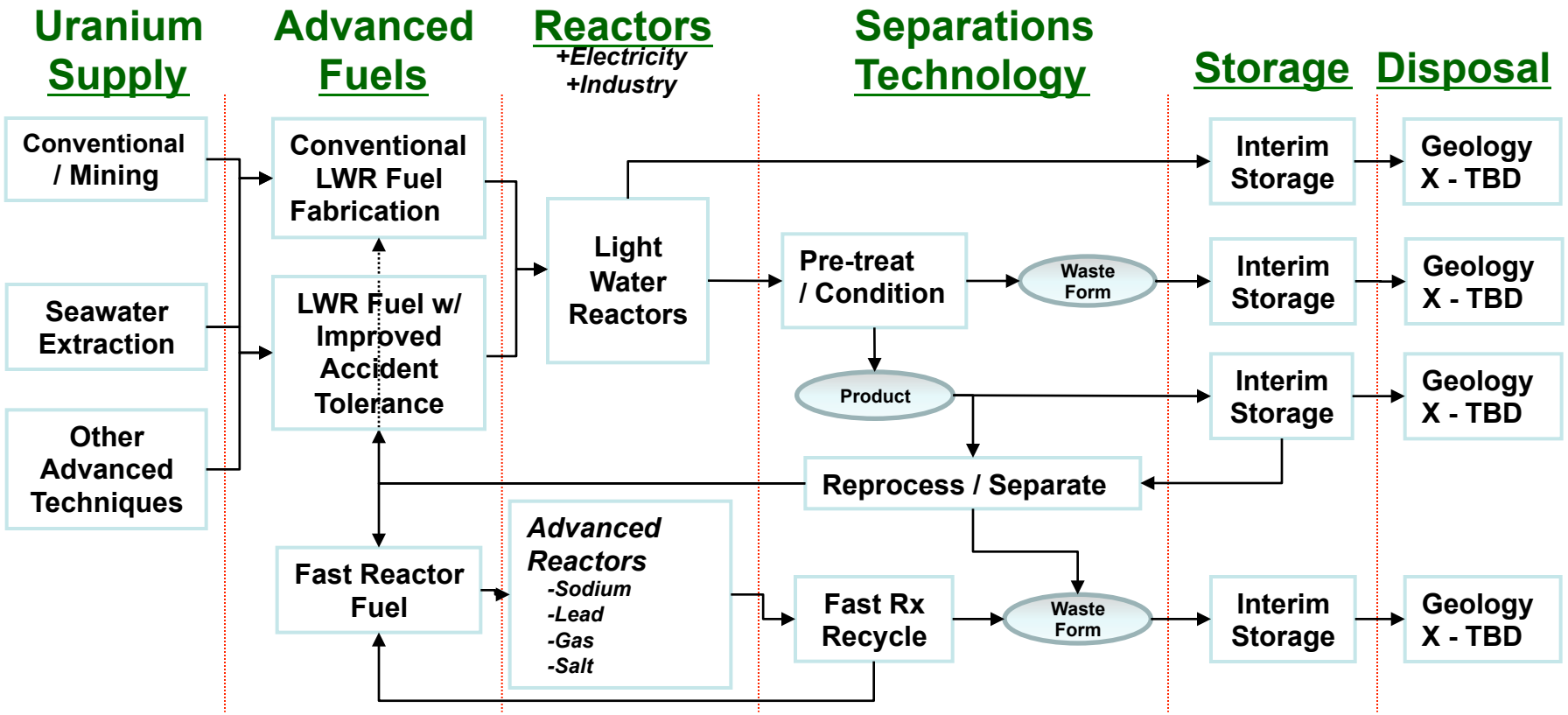
Fuel Cycle as a System



- Optimized System: We want the best performance for each step in harmony with other parts of the system
- Near-Term/Long-Term Balance: Seek near-term applications while maintaining the long-term objective of a sustainable fuel cycle

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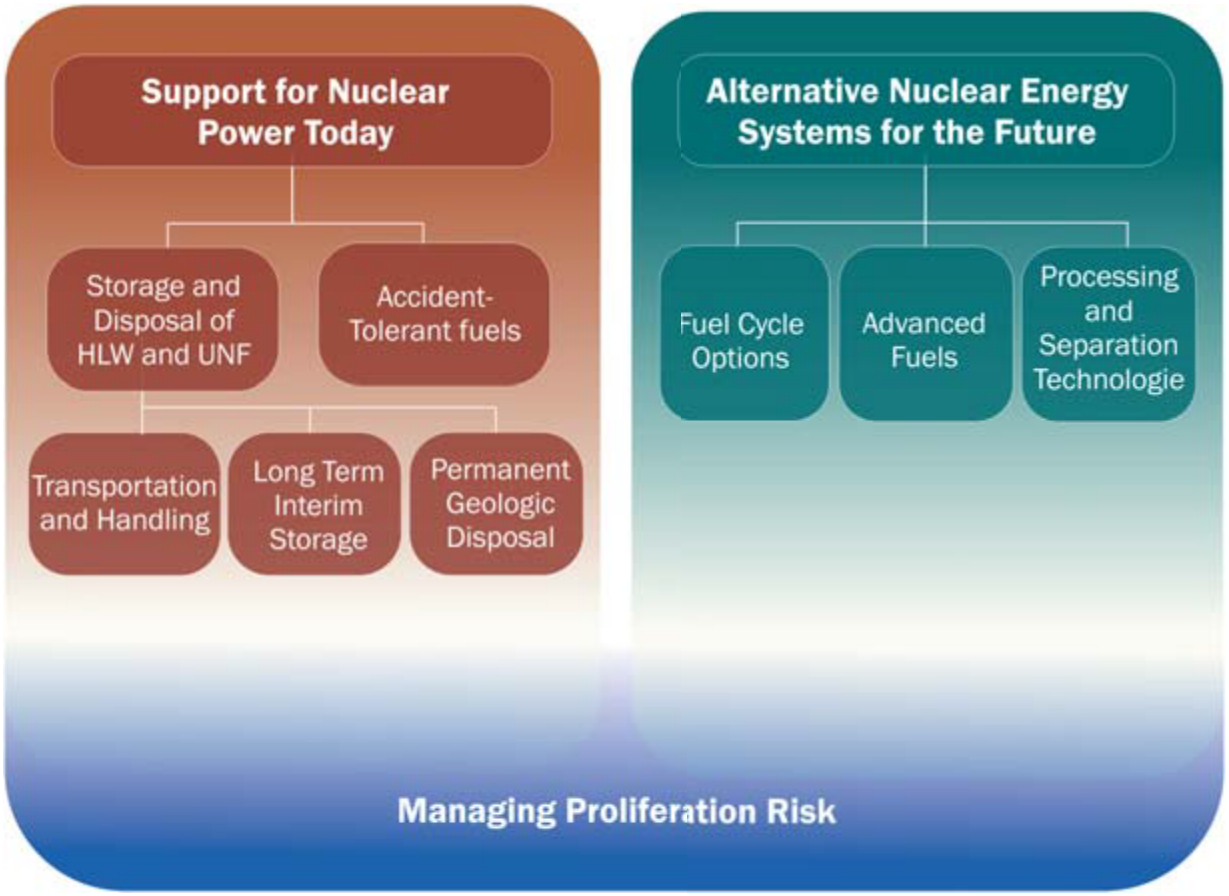
Balancing Near-Term and Long-Term Objectives



- Satisfy increasing demand for near-term action on used nuclear fuel storage and transportation and for accident-tolerant fuels.

- Maintain the momentum for long-term R&D activities with the potential for game-changing improvements.

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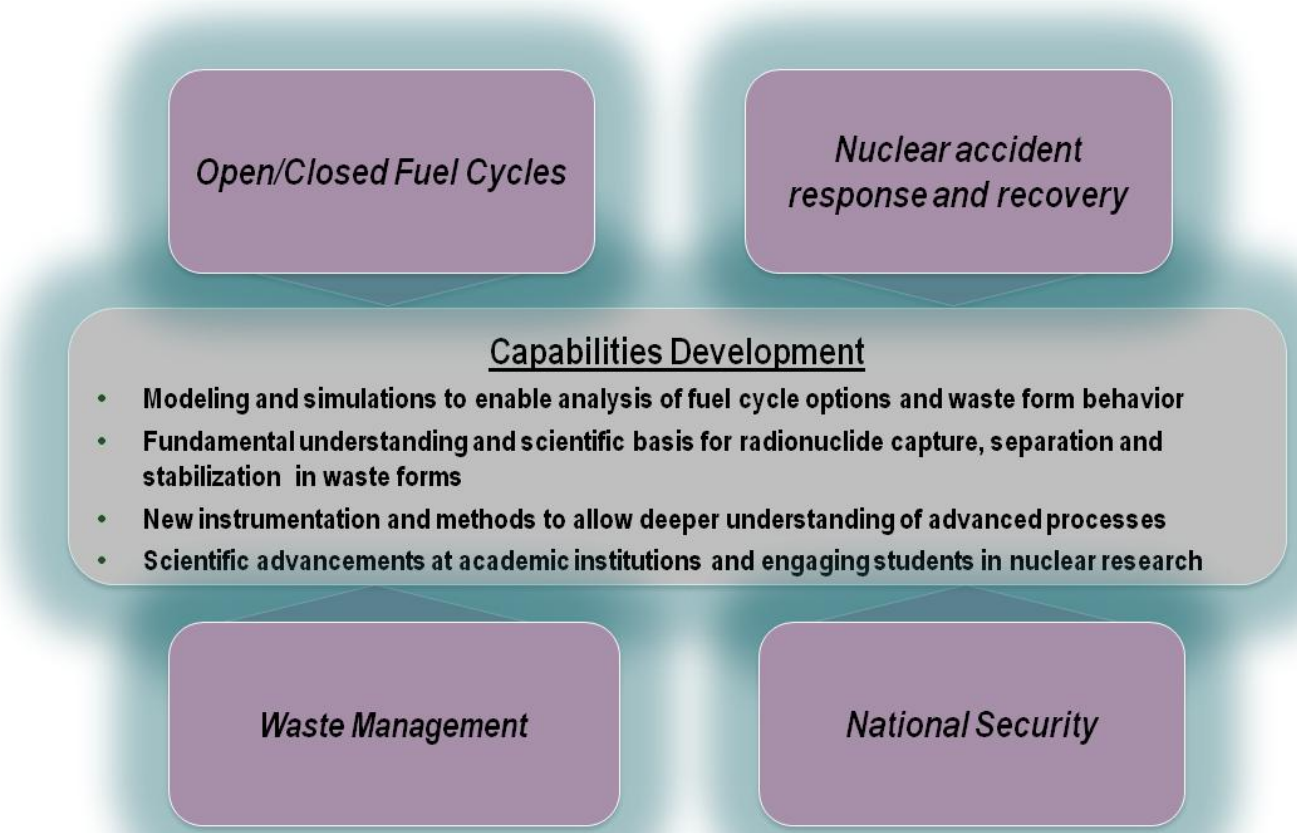
Material Recovery and Waste Forms



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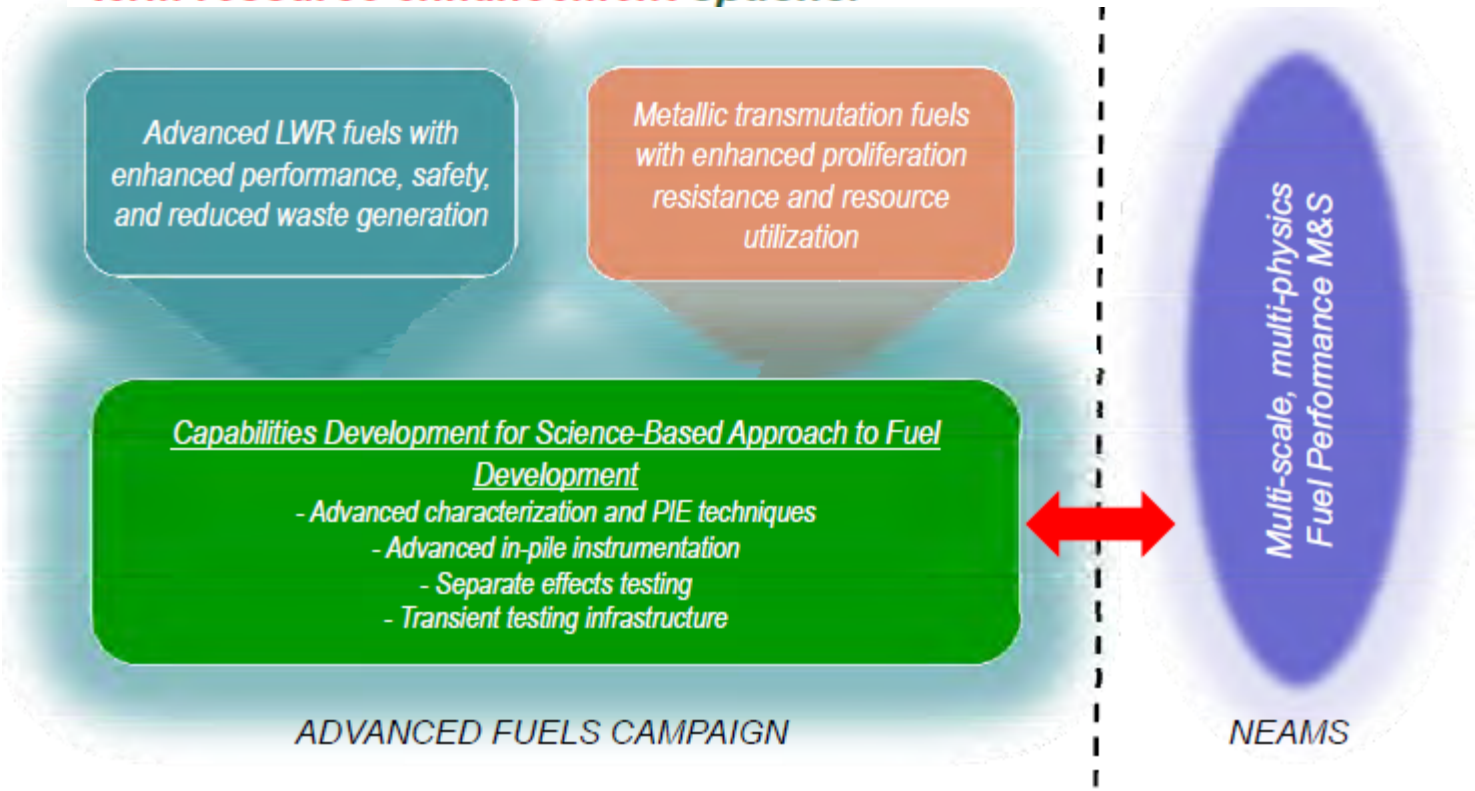
Advanced Fuels

The FCRD Advanced Fuel Campaign is tasked with development of near term Accident Tolerant LWR fuel technology and performing research and development of long term resource enhancement options.



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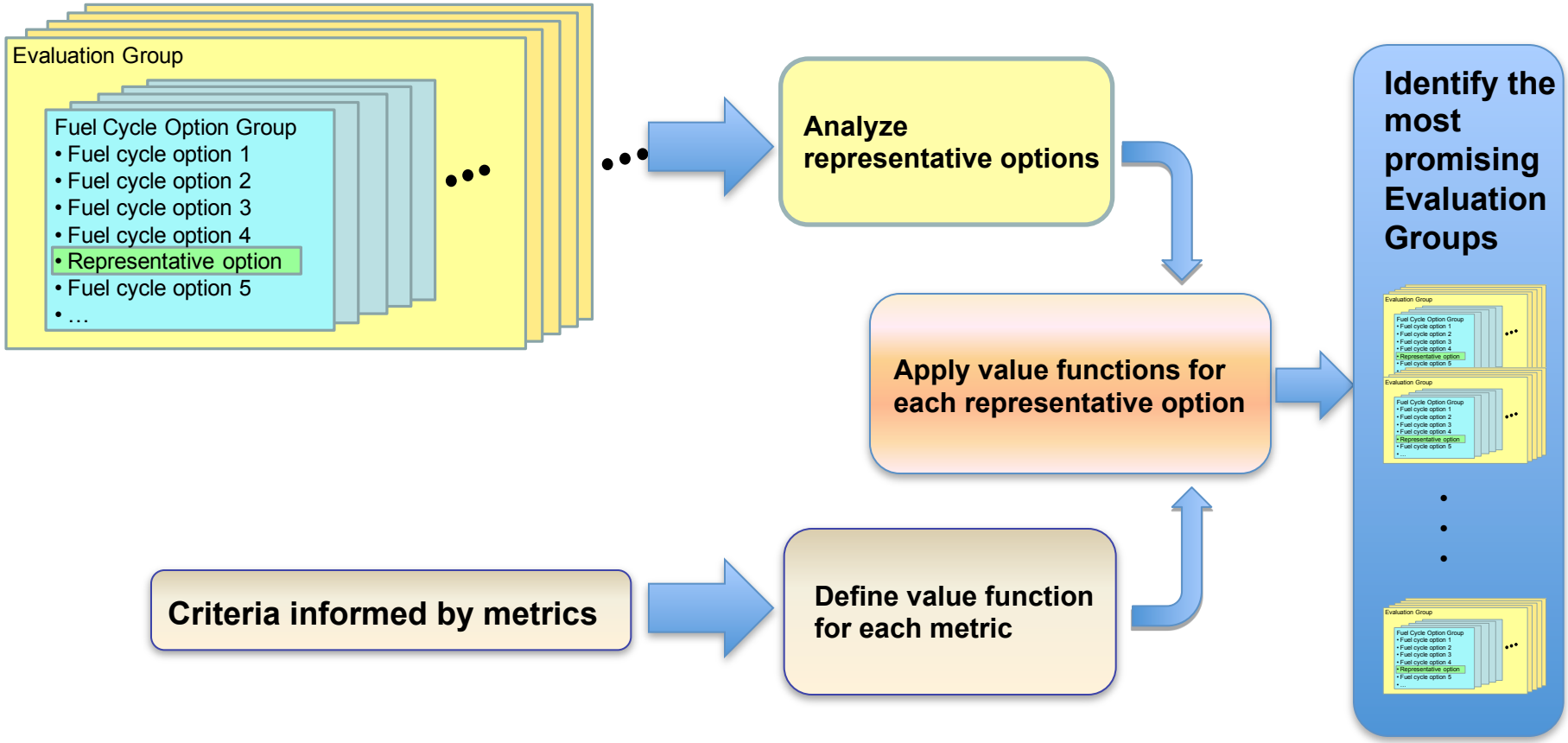
Systems Analysis and Integration



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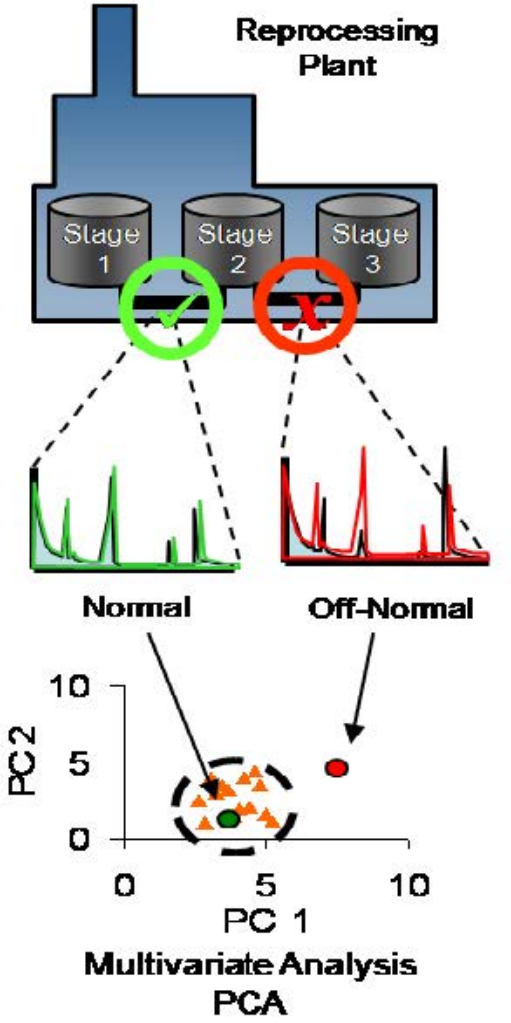
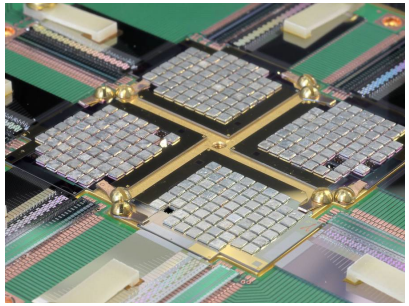
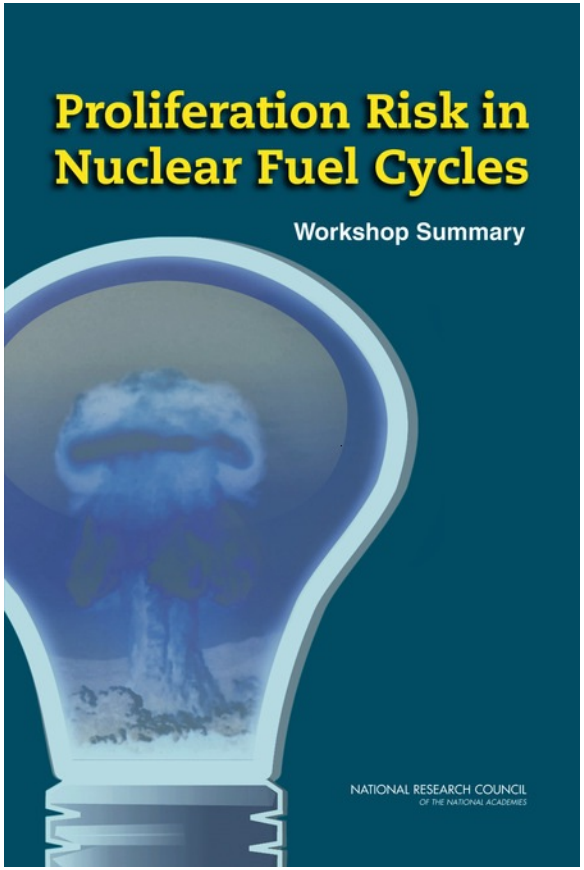
Materials Protection, Accounting, and Control Technology (MPACT)



Supports innovative new methods for proliferation and terrorism risk assessment and the development of sensors to fill gaps in nuclear materials protection, accounting and control





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Used Nuclear Fuel R&D: "Storage and Transportation"

Goal: In support of NRC licensing, develop the technical basis to support UNF management with a strong emphasis on high-burnup spent fuel.

Objectives:

- Fuel retrievability and transportation after extended storage
- Technical data to support NRC licensing for long-term storage of High-Burnup fuels

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High-Burnup Dry Storage R&D Project

- **Goal - Develop the technical knowledge and the capability to examine high-burnup UNF to support NRC licensing for long-term storage.**
- **Involves:**
  - Loading a commercial storage cask with high-burnup fuel in a utility storage pool
  - Drying of the cask contents using prototypic process
  - Cask will be housed at the utility's dry cask storage site
    - Continuously monitored and externally inspected until the first internal inspection at ~10 years
- **Initiate activities at INL to open the cask by adapting existing facilities.**

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Used Nuclear Fuel R&D: "Disposal"

- **Provide a sound technical basis for multiple viable disposal options in the US**
- **Increase confidence in the robustness of generic disposal concepts**
- **Develop the science and engineering tools needed to support disposal concept implementation**
- **Leverage international collaborations**